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ABSTRACT

A discriminant analysis was performed to ascertain what psycho-educational assessment variables made the greatest predictive contribution to the classification of high school students referred for Child Study Team evaluation. Thirty-nine students classified as learning disabled were compared to 47 classified as ineligible for special services. Variables found significant were the Full Scale Intelligence Quotient, the Wide Range Achievement Test (WRAT) arithmetic subtest, a question from the student interview, and most importantly the WRAT spelling subtest. Includes 18 references. (PB)

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A Discriminant Analysis of Variables Related to the Classification of Students with Learning Disabilities: A Field-Based Investigation[1]

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Abstract

A discriminant analysis was performed to ascertain what psycho-educational assessment variables made the greatest predictive contribution to the subject classification of high school students referred for Child Study Team evaluation. Data that were normally collected by each of three school psychologists as part of their professional roles were analyzed. From an original pool of 119 students, the 39 classified as learning disabled were compared to the 47 classified as ineligible for special services. Four variables significantly discriminated the two groups and the resulting discriminant function correctly classified 79% of the students in the present sample and 97% in a cross-validation using 34 new referrals. The most important variable was the Wide Range Achievement Test (WRAT/WRAT-R) Spelling subtest which accounted for 20.5% of the variance. The Full Scale IQ score, WRAT/WRAT-R Arithmetic subtest and a question from the student interview ("Do you think going into a special class/program would help you?") were the other significant discriminators. The discussion addresses the capacity for diagnostic processes to result in learning disability classification that conforms to a current definition. Two other important contributions of the present study were the use of actual cases in a naturalistic setting and the pertinence of the results to significant contemporary issues.

A Discriminant Analysis of Variables Related to the Classification of Students with Learning Disabilities: A Field-Based Investigation

Intrinsic to successful placement of students in special education is the accurate identification and classification of students with special needs and problems. Over the past two decades there has been considerable debate concerning the criteria for identification of students with learning disabilities. Not only must a learning disability be identified, but educators have the task of selecting those students with "true" learning disabilities from a large population of students experiencing many kinds of academic and behavioral difficulties (Ysseldyke, 1982). Certainly, the lengthy and unresolved search for definitive characteristics raises many questions about the adequacy of the traditional model of handicapping conditions in general (Johnson, 1975). Johnson noted that traditional differential diagnosis assumes that every disorder has identifiable characteristics. Yet, differential diagnosis itself is complicated in special education by the overlap in several of the category definitions. Both learning and behavior problems are frequently associated with emotional disturbances, learning disabilities and mental retardation. These problems vary in severity, and when

the diagnostic characteristics are less extreme, decisions are not clear-cut.

Adelman (1978) suggested that despite the large body of literature on diagnosis of learning problems there has been little systematic information gathered about the basis professionals use for assigning labels. Conclusions have been contradictory and offer little clear guidance to professionals. The lack of consistent research in this area may be attributed in part to changes in federal and state definitions and criteria over time.

Not only has there been disagreement about the criteria, but also about which tools should be used for identification. The issue of whether or not to use a formula-based procedure continues to be difficult to resolve (Danielson & Bauer. 1978). After the passage of Public Law 94-142, The Education for All Handicapped Children Act (1975), the Federal Department of Education proposed a formula-based means of identifying learning disabled students. The formula received strong opposition which led to its elimination. Objections to the use of formula-derived results included concerns about the validity of IQ tests, as well as the fact that the very testing of a learning disabled child precludes valid measurement of their ability.

Another method of classifying students is to use

"inclusionary/exclusionary" criteria whereby a student exhibits specific features of one category and not of another. This method has reliability problems and has led to the wide variance in the number of learning disabled children identified.

Accurate identification and classification is vulnerable to the personal bias of evaluators. In addition to these personal leanings, issues such as funding, research outcomes, cultural milieu, and training greatly influence decision making (Johnson, 1975). In an investigation of interjudge agreement in classifying students as learning disabled, Epps, McGue and Ysseldyke (1982) concluded that "there is considerable doubt that school personnel can accurately and reliably identify such students" (p. 219). Even when a student has been identified, the mere movement of a student from one school district to another may include or exclude a student from being labeled as handicapped due to the theoretical and procedural differences alluded to above.

One consistency in identification has been the use of test batteries for making decisions (Ysseldyke & Thurlow, 1983). Yet, despite the large amount of time that is spent testing, test-based assessment still has many limitations (Marston, Tindal, & Deno, 1982). Such issues as whether psycho-educational testing has utility in

instructional planning (Thurlow & Ysseldyke, 1982) and differences between child study team members' views of the importance of various tests (Becker & Snider, 1979; Matuszek & Oakland, 1979; Thurlow & Ysseldyke, 1982) are still not resolved. Additionally, mixed findings from IQ test research and unanswered questions about whether tests adequately discriminate students with learning disabilities from low achievers (Marston et al., 1982) remain unanswered. Even the accuracy of team decision making in using assessment information is questionable. It has been reported that there is a minimal relationship between child study teams' classification decisions and test-based eligibility criteria (Ysseldyke & Thurlow, 1983).

Regardless of the inherent problems in test-based assessment and decision making, it is nonetheless the established method for providing validity and objectivity to special education placement. The choice of assessment devices to be included in the evaluation process then becomes a crucial factor. Rather than selecting or rejecting devices on a solely subjective basis, Wendler and Roid (1984) suggest a model that offers a logical, cost-effectiveness approach to test selection. Cost was determined by combining the cost of the test used plus the costs associated with the test's administration. In

addition, an efficiency formula and a cost-effectiveness ratio were determined. Evaluating the cost-effectiveness of combinations of the Wechsler, Bender and Woodcock-Johnson, the authors suggested that, based on cost alone, the Wechsler and Bender combination would be chosen. Yet because this combination provided less diagnostic information than the Wechsler and Woodcock-Johnson combination, the latter provided the optimal ratio of cost to information. The Bender and Woodcock-Johnson was much less expensive, but would not provide IQ information. It was further concluded that although it is sometimes assumed that using a greater number of tests will provide more information, the addition of the Bender provided little increased classification accuracy and does not warrant the cost.

Knoff (1983) had school psychology and special education practitioners and trainees independently rate the importance of 16 pieces of diagnostic and background data for special education placement decisions. The results suggested that classroom observation, assessments of expressive and receptive language, an interview with the referred child, and emotional indicators were most important to the placement decision. However, the data were evaluated in an isolated fashion, neither representing actual cases nor the multidisciplinary team

process. The results of this study have interesting implications regarding identification and provide quantified professional opinion, but may or may not indicate which factors actually predict special education placement.

The present study was designed to provide field research regarding the predictive qualities of commonly used assessment procedures in the identification of students with handicaps. The data were collected as part of the normal on-going activities of school psychologists. Demographic and psychometric data were recorded for students being evaluated and later a discriminant analysis was used to see what factors were related to actual child study team decisions. A discriminant analysis statistical procedure was applied to determine if the special education category decision of the multidisciplinary team could be predicted.

Study 1

Methods

Subjects

During the data collection phase of this study a total of 119 high school students were processed through the Special Education Department's comprehensive evaluation procedures. The testing was administered by the three district school psychologists who serve four

high schools. Three of these schools are located in a university community of about 70,000 people and one is in a rural location. Seventy-six males and 43 females made up the study sample. Subjects ranged in age from 14 to 19 and grades 9 to 12. All subjects were students within the district at the time of the evaluation and none had been served by special education during the three previous years. Students evaluated were referred routinely through the district's special education procedures in which the class counselor processes the referral.

Instruments

The following demographic data were collected: school, sex, age, grade, number of academic credits completed, and total number of schools attended. Nearly every subject was tested with the following instruments: Wechsler Intelligence Scale for Children Revised (WISC-R) or Wechsler Adult Intelligence Scale Revised (WAIS-R), Wide Range Achievement Test (WRAT) or revised version (WRAT-R), Beck Depression Inventory, and the Coopersmith Self-Esteem Inventory. In addition, locally developed teacher information reports and a student interview which utilized a 1-5 rating scale were also recorded. Students being evaluated for an emotional disturbance may have had an Achenbach Child Behavior Checklist (Parent), High School Personality Questionnaire, and/or MMPI

administered. When appropriate subjects were interviewed by the district clinical psychologist as part of the evaluation procedure and the psychologist's ratings (5-point scale) were recorded as well.

Procedures

Test data were collected and recorded during the 1983-84 and 1984-85 school years. All methods were part of the normal special education comprehensive evaluation. There was no need to inform subjects or parents that data were being recorded as the data would normally be collected as part of the school-provided special education services. Subject numbers were assigned to ensure anonymity. The school psychologists made predictions of subjects' possible special education category. Six different predicted categories were possible: learning disabled, emotionally disturbed, educable mentally retarded, multiply handicapped, other health impaired, and non-admittance. The first five choices being categories as defined by the Montana State rules and regulations for special education. The sixth category of non-admittance was for any individual who did not quality under any of the first five handicapping conditions. After the child study team (CST) meeting was held, the psychologist recorded the actual category determined by the team. The actual special education handicapping

categories were the same alternatives used for the predicted categories.

Results

Of the six categories used for classification of children, two contained the majority (103) of the 119 subjects who were either classified as learning disabled or as not needing any special services (non-admittance). Eliminating subjects with missing data on variables being considered for the discriminant analysis left 39 children categorized as learning disabled by the child study team and 47 classified non-admittance indicating that they did not qualify under any of the handicapping criteria used. The 33 students distributed across the other four categories resulted in the number in any one category being too small to allow a reliable conclusion from a discriminant analysis, and so these were not included in the analysis.

Discriminant function analysis was used in this study to permit the determination of the best combination of variables that when used as predictors would result in maximum differences between groups. Procedures discussed and explicated by Tabachnick and Fidell (1983) were followed although the interested reader may find other sources equally informative (e.g., Finn, 1974).
Our question was whether a differential diagnosis between

learning disability and non-admittance could be made reliably on the basis of a set of the psychological test scores, interviews, and behavioral assessments collected in this district.

A stepwise discriminant analysis was run using the SPSSX computer package. The parameters used for the discriminant analysis required minimum F-value of 3.1 to enter a variable and a maximum F-value of 2.5 to remove a variable. The selection rule was based on a maximation of Rao's V.

There was a statistically significant discrimination between the two groups on the basis of four variables, $F(4,81) = 8.92$, $p < .0001$. The most important variable was the WRAT/WRAT-R for Spelling which accounted for about 20.5% of the variance. The Full Scale IQ scores, WRAT/WRAT-R for Arithmetic and a question from the student interview ("Do you think going into Special class/program would help you?") each added about 5% more to the variance accounted for by the discriminant function. The weights for the discriminant function are as follows: 0.0902 for WRAT Spelling, -0.0405 for Full Scale IQ, 0.0407 for WRAT Arithmetic, -0.3704 for the student interview question, and -6.5999 for the constant.

To examine the adequacy of the discriminant function in classifying cases, the 97 high school students who had

complete data on the variables used in the discriminant function were selected from the 103 learning disabled and non-admittance sample. The equation correctly classified 79% of them with correct classification of learning disability (82%) being slightly higher than the rate in correctly predicting a non-admittance classification (77%). In evaluating a discriminant function, it can be informative to determine if classification improves over base rates when the predictor variables are used to classify. McNemar's repeated-measures chi-square test for change is used to assess this improvement (Tabachnick & Fidell, 1983, p. 328). In our case, the test for change in proportion of correct classification using the four variables shown to be important above, revealed statistical significance for the gain in classification performance, $\underline{X}^2(1) = 11.02$, $\underline{p}<.01$.

It is also suggested (Tabachnick & Fidell, 1983) that it is of interest to see how the groups differ on predictor variables that are shown to discriminate among groups. Thus, we examined the means and performed $\underline{t}$-tests for differences between groups for each of the four significant variables. The results are summarized in Table 1. Each comparison utilized all subjects for which

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Insert Table 1 about here

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data was available on the two variables being compared. The learning disabled group of children did not differ from the non-admittance group on age, grade or full scale IQ as can be seen in Table 1. The table also includes statistics for other variables of interest.

Many variables not in the discriminant function yielded significant t-values. However, due to intercorrelations among variables, each one does not contribute sufficient independent information to be included in the discriminant function. A number of correlations of interest are displayed in Table 2.

Insert Table 2 about here

In discriminant analysis it is important to cross-validate the results. Thus, we asked whether the same predictor variables would again adequately classify children into the categories of learning disability and non-admittance.

Cross-Validation

Without knowledge of the outcome of Study 1 (since data analysis had not been completed at this time), two of three school psychologists recorded data as before for another 34 students. The new sample was very similar to the first one, having a mean age of 15.7 years, a mean

grade of 9.9, and a mean full scale IQ of 98.6.

The discriminant function from Study 1 was applied to the data from the 18 non-admittance and 11 students classified as having learning disabilities (out of the 34 total) in sample two. Of these, 28 were classified correctly for a 97% accuracy rate. The only mistake made by use of the statistical equation was that one child was classified as having a learning disability, but the actual decision made by the child study team was non-admittance. The cross-validation yielded strong support for the validity of the results from Study 1.

Discussion

As indicated in the introduction, the present study was an effort to gather information in a naturalistic setting regarding the effectiveness of child study team assessment/evaluation processes in identifying students with handicaps. The three school psychologists involved in this study gathered commonly collected assessment data as they carried out their comprehensive evaluations with referred high school students. Discriminant analysis was applied to that data to consider which assessment techniques were most predictive of eventual child study team placement. The resulting discriminant function identified variables which were measures of primary components of the federal and state special education

definition(s) of learning disabilities. The identified variables were achievement (WRAT spelling and arithmetic), aptitude (Wechsler Full Scale) and student interest/ motivation (Do you think going into a special class/ program would help you?). The discriminant analysis function obtained in the study effectively differentiated between high school students with learning disabilities and high school students without special education handicaps.

Recent discussions regarding learning disabilities by Algozinne and Ysseldyke (1986), Adelman and Taylor (1986), Reger (1979), and Torgesen (1986) have focused upon definitional and differential diagnosis issues. Torgesen (1986) has suggested that one possible reason for definitional problems in the field is due to the field's rapid growth as a political-social entity, rather than as an area of scientific inquiry. Torgesen further proposed that the need exists for researchers to develop their own set of procedures in working in the field of learning disabilities. The current study did not address definitional issues. However, the results clearly suggest that it is possible to effectively implement the federal and state definitions of learning disabilities. The discriminant function indicated that the variables predictive of the learning disabilities or non-admit

categories assigned by the CST were indeed representative of those prescribed by the regulation definitions.

The findings of earlier research (Knopf [1983] using professionals' opinion ratings, Wendler and Roid [1984] using a cost effectiveness model, and Matuzek and Oakland [1979] using CST member views) emphasize different variables than our field-based assessment focused study. Knopf's findings regarding the importance of student interview and Wendler and Roid's regarding the importance of the Wechsler scale are consistent with the emphases implied by the current findings. However, the earlier studies don't necessarily identify factors that were actually predictive of the decisions reached by the CST. Instead, they sampled what factors professional and trainees believed to be important. The current study used a systematic statistical process to evaluate the predictive contribution of various data to the CST classification of students with learning disabilities.

It does not necessarily follow that such classifications would result in separate groups who differ in fundamental ways requiring different educational programs. That is, we are not taking a stand based on our data that categorization which abides by the federal definition is or is not an instructionally useful and meaningful process, or that it would be diagnostically

valid. Rather, we offer clear evidence that the evaluation processes used here differentiated students in accordance with established definitions.

Our results should be reassuring regarding some of the doubts expressed by Epps, McGue, and Ysseldyke (1982). However, we are not addressing specifically what a "true" learning disability (Ysseldyke, 1982) is or what the precise utility of such categorizations might be for educational planning (Thurlow & Ysseldyke, 1982).

Current findings of high agreement (96%) between the school psychologist's predicted category and the actual CST categorization may also indicate a consistent implementation of the definition of learning disabled using the available information. It needs emphasizing that these predictions by the psychologists were made in light of their own collected information and other relevant information the CST considered. Thus, one would not want to conclude that the high agreement between psychologists' labels and actual labels should suggest a more single-handed approach; that is, that the data indicate that the school psychologists were manipulating the CST's final decision. We strongly support the crucial role of the CST in processing information with regard to classification and placement decisions and note their important role in program communications.

Further evidence for the usefulness of the CST can be shown by noting that students classified as having learning disabilities were then placed in one of five different possible programs. In addition, students who were not admitted into special education were placed into four different programs depending on their specific needs. The program the school psychologists recommended and recorded prior to the CST were in agreement with the final disposition in 91% of the cases. Although this is also a high percentage, the fine tuning performed by the CST is evident and the open communication and understanding between parents, teachers, administrators, and psychologists is probably invaluable.

As an interesting aside, we would note that the orthogonality of the components in discriminant analysis is analogous to the presumed independence of methods used by child study teams. Just as members of the CST make unique contributions to the decision process, so are the variables in the discriminant functions selected by the extent to which they contribute unique information to accurate classification. For example, the achievement and aptitude measures proved to be independent of the student interest/motivation measure in this study. Further, the discriminant analysis did not select WRAT-Reading as one of the variables for the discriminant function defined

here since it did not offer information independent of WRAT-Spelling in identifying these high school with learning disabilities.

Viewed from another perspective, discriminant analysis as used in this study offers a program evaluation technique. If the factors accounting for the variance are, as they were in this study, representative of definitional components, then it would suggest that the data gathering/decision-making process is attending to those components.

Finding that the Wechsler and an achievement measure were predictive of a learning disabilities categorization was not surprising in light of the central role each plays in definitions. The finding that a spelling, rather than reading or mathematics measure, was most predictive brought some afterthoughts. It seems likely that among high school students with learning disabilities, those most likely to be identified in elementary school would first be those with reading and then with mathematics difficulties because of the relative emphases placed on those subject areas at earlier grade levels. Thus spelling, with the emphasis upon written work in high school, might bring forth some additional referrals and lead to identification of students not placed earlier.

The current study has certain limitations. First,

the sample was too small to allow other categories of handicapping conditions to be investigated. Further, it pertains only to a senior high school population in one suburban Montana community. It used the WRAT/WRAT-R for measures of achievement when there may be others that would provide more reliable and relevant information for CST decisions.

Future research directions include discriminant analysis studies which deal with larger samples with broader age and sociocultural ranges. Future studies should attend to other assessment techniques commonly used in classifying students.

The student interest/motivation variable identified here suggests an interesting area for further research. High school students labeled as having learning disabilities in this study evidenced an awareness of their need for remedial assistance and a willingness to participate in special education classroom settings. Non-admit subjects were clearly identified as not having an interest in any special help. This may reflect a student maturation variable which would appear to be an important dimension in high school programming.

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Footnote

[1]Portions of this investigation are included in a "Research Brief" expected to appear in the Journal of Learning Disabilities.

Table 1

Individual t-tests on the Four Variables Found Significant in the Discriminant Analysis

	Learning Disabled Mean	Non-Admittance Mean	t	df	Sig
Full Scale	98.6	99.8	0.51	101	.689
WRAT Spelling	84.6	95.3	5.71	98	.001
WRAT Arithmetic	86.7	93.3	2.93	96	.004
Student Interview #4[a]	3.5	2.99	2.67	100	.009
WRAT Reading	94.98	103.25	3.31	98	.001
Age	15.8	15.6	0.94	101	.348
Grade	10.0	10.1	0.38	101	.702
Verbal IQ	97.1	101.6	1.85	101	.068
Performance IQ	100.8	100.6	0.08	101	.934
Verbal-WRAT Read[b]	2.23	-2.55	2.33	98	.022
Verbal-WRAT Spell	12.57	5.39	3.33	98	.001
Verbal-WRAT Arithmetic	10.48	7.48	1.19	96	.236
Performance-WRAT Read	5.86	-2.77	3.00	98	.003
Performance-WRAT Spell	16.20	5.18	3.05	98	.001
Performance-WRAT Arithmetic	11.93	5.98	2.07	96	.041
Full Scale-WRAT Read	3.68	-4.13	2.85	98	.005

Table 1 (continued)

	Learning Disabled Mean	Non-Admittance Mean	t	df	Sig
Full Scale-WRAT Spell	14.02	3.82	3.68	98	.001
Full Scale-WRAT Arithmetic	11.93	5.98	2.07	96	.041 19
Verbal Comprehension	9.08	9.62	3.71	101	.213
Perceptual Organization	10.28	10.27	0.03	101	.977
Freedom from Distractibility	8.20	9.52	3.50	100	.001
Acquired Knowledge	8.11	9.18	2.51	100	.014
Arithmetic Coding Information and Digit Span	8.09	9.32	3.49	100	.001
Student Interview #5	3.47	3.02	2.37	100	.020

[a]Do you think going into a special class/program would help you?

[b]Indicated IQ score minus the indicated achievement test score.

Table 2

Correlations Among Variables in Discriminant Function

	LD[a]	WRAT Spell.	FS	WRAT Arith.	Student Interv. #4
WRAT Spell	-.50 (.001)[b]				
Wechsler FS	-.04 (.348)	.36 (.001)			
WRAT Arith	-.28 (.002)	.28 (.003)	.41 (.001)		
Student Interv. #4	+.26 (.004)	-.17 (.058)	-.09 (.192)	-.10 (.165)	
WRAT Read	-.31 (.001)	.77 (.001)	.48 (.001)	.33 (.001)	-.16 (.058)

[a]Actual category where LD classification was assigned a value of 1 and not placed a value 0.

[b]Significance level.

Note: Sample sizes vary from 98 to 103 and represent only learning disabled or non-admittance students.